Course outline: Chem 2281 – Inorganic Chemistry of the Main Group Elements

Description – Comparison of the structure and solution chemistry of the main group elements and their oxides, halides and hydrides; examples of these compounds in the world around us, with a discussion of the chemical principles involved; Molecular Orbital Theory of polyatomic molecules; metallic bonding and semiconductors.

Prerequisite Requirements – The prerequisite for this class is Chem 2271A or Chem 2211A/B with a minimum grade of 80%. Unless you have either the prerequisites for this course or written special permission from your Dean to enroll in it, you may be removed from this course and it will be deleted from your record. This decision may not be appealed. You will receive no adjustment to your fees in the event that you are dropped from a course for failing to have the necessary prerequisites.

Instructor: Professor John F. Corrigan (JFC)
CHB 16
corrigan@uwo.ca (only send email from your UWO account)
@CorriganLab (Twitter)

Laboratory TAs: Devon Chapple, dchapple@uwo.ca
Megan Hoffer, mhoffer3@uwo.ca
Seyedeh Raoofi, sraoofi@uwo.ca
Amrit Singh, asing826@uwo.ca
Nils Vogeler, nvogeler@uwo.ca

Office hours: Online via Zoom
Mondays 14:30-15:20

Course Webpage: OWL (https://owl.uwo.ca/portal)

Course schedule: Lectures: 3 hours per week; M W F 12:30 – 13:20
Location: Online via Zoom; in-person* in NCB-117

*The current plan is to have in-person lectures as soon as safety protocols permit (as of 31.01.2022). Dates may be pushed back depending on university/provincial guidelines or restrictions in which case synchronous delivery via OWL/Zoom will continue.

Laboratory: 8 x 3 hour laboratory sessions during one of the following:
Tuesday: 09:30 – 12:30 OR 14:30 – 17:30
OR Wednesday 14:30 – 17:30
OR Thursday 14:30-17:40

In person laboratories are held in ChB 080 (lower ground floor). The laboratory schedule is appended to this course outline and posted on OWL. Note that labs begin the week of January 24 with a mandatory library information session via Zoom. The balance of the Chem 2281 laboratory experience will be in person (safety protocols permitting).
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Required Text – Inorganic Chemistry, 5th Edition (Miessler, Fischer and Tarr)
This textbook was used in Chem 2271 and will be your textbook for Chem 2281. If you require a copy, this book is available for purchase at the UWO Campus Bookstore. Second hand copies are also generally available and don’t forget to check the library!


Laboratory Notebook (for in person labs) – A hard covered and bound laboratory notebook is needed for recording all data and observations in the laboratory. A partially filled one from another course will be fine. Be sure to clearly indicate where the Chem 2281 experiments begin. **Do not use a notebook for a course you are taking concurrently with 2281.**

Molecular model kit – strongly recommended.

Safety glasses – Are required at all times when working in the laboratory. Students who normally wear prescription glasses must wear safety glasses or goggles over their regular glasses. A lab coat is also required. Full details are in your laboratory manual.

Evaluation

<table>
<thead>
<tr>
<th>Test/Assignment</th>
<th>Date</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test #1 – in class</td>
<td>February 4, 2022</td>
<td>15%</td>
</tr>
<tr>
<td>Test #2 – in class</td>
<td>March 4, 2022</td>
<td>15%</td>
</tr>
<tr>
<td>Assignments (≈4-5; distributed throughout the term)</td>
<td></td>
<td>5%</td>
</tr>
<tr>
<td>Laboratory</td>
<td></td>
<td>25%</td>
</tr>
<tr>
<td>Final Exam (cumulative) - scheduled by the Registrar</td>
<td></td>
<td>40%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>100%</strong></td>
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</table>

In order to obtain a passing grade in Chem 2281, it is necessary to obtain a passing grade on the laboratory component and the combined marks from the tests and final examination. In addition, students must complete ALL experiments with the corresponding completed reports handed in. A minimum of 50% on the final examination must be obtained to pass the course.

Attendance at lecture is mandatory – You will only be successful in Chem 2281 if you have regular lecture attendance.
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Course-Based Learning Outcomes:

Upon completion of Chem 2281G, students will be able to:

(i) Understand and identify the symmetry elements and operations to be able to assign the correct point group of molecules

(ii) Apply the understanding of symmetry elements in molecules and operators for the construction of molecular orbitals

(iii) Interpret and predict the chemical properties of main group elements/molecules in of the bonding theories typically used to describe them.

(iv) Conduct laboratory experiments safely and evaluate the potential impact of main group chemistry

(v) Prepare logical, organized, and concise written reports describing their experimental results in the areas of the preparation and characterization of main group complexes

Important Dates:

January 10th – First day of class
Week of January 24th – First week of labs (via Zoom)
Week of February 1st – First week of in person labs
Feb 4 – Test #1
February 19-27th – Reading week
March 4 – Test #2
Week of March 21st – Last week of labs
April 8th – Last day of classes
April 10-30 – Final Exam Period (date for Chem 2281G TBA by Registrar)

Lecture topics (tentative)

Course intro; Review on Bonding (Lewis, VSEPR, VB)

Introduction to symmetry and point groups

Character tables; symmetry of orbitals and functions; character tables and bonding

Constructing qualitative MO diagrams using symmetry and character tables

Symmetry and molecular vibrations
Course outline: Chem 2281 – Inorganic Chemistry of the Main Group Elements

Selected chemistry from p-block – Polyhedral boranes; High valent Lewis acidic cations; oxo-acids; heavy element multiple bonding; low valent atom centres; carbene stabilization of reactive species.

Chem 2281 hand-in format for grading of ALL work – ALL documents submitted electronically must be converted to pdf, set to 8.5 x 11 inches (US letter format). Any other document format (e.g. MS Word; image files, etc.) or document size (e.g. A4, Legal) will not be accepted and will be assigned a mark of zero. This formatting requirement is not negotiable. If you do not know how to convert documents to a pdf with the noted page size, you must learn to do so for this course.

Late Policy for Chem 2281G – All work is subject to a late policy of 10% per day, including weekends. Work more than three days late will not receive any credit. Late policies will be waived provided students have a valid reason that is supported by the academic counsellors from their home faculty. For the Laboratory ... Students are welcome to submit a Self-Reported Absence or gain accommodation from an academic counsellor. See “Accommodations” section for further detail.

Laboratory Reports - Each lab will be given a mark out of 10, except the formal report, which will be graded out of 20. Laboratory notebooks will be evaluated (write as you go!) and a laboratory performance grade assigned by the TAs. Overall, the lab component will be marked out of 100, which will be converted to contribute to your overall mark for Chem 2281G (25% of course total).

Weight of laboratory components:

<table>
<thead>
<tr>
<th>Component</th>
<th>Percentage</th>
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</thead>
<tbody>
<tr>
<td>Lab performance (notebook, fluency, lab safety &amp; responsibility)</td>
<td>10%</td>
</tr>
<tr>
<td>Library Lab sheet</td>
<td>2.5%</td>
</tr>
<tr>
<td>Symmetry Lab sheet</td>
<td>2.5%</td>
</tr>
<tr>
<td>Pre-labs for each experiment (6 x 2.5%)</td>
<td>15%</td>
</tr>
<tr>
<td>All lab reports with data sheets (5 x 10%)</td>
<td>50%</td>
</tr>
<tr>
<td>Carbon Quantum Dots (formal lab report)</td>
<td>20%</td>
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</table>

Total 100%

Report Sheets – All but one of the labs will be “written up” in a report sheet style, where the sheets are included as a component of this lab manual. Don’t be afraid to fill in some of the answers as you go, if time allows. Work efficiently, don’t waste your time. The 2281G lab is supposed to enhance the class, not be a class unto itself.

Pre-lab, report sheet ‘write-ups’ and formal lab hand in. Pre-lab: All pre-labs will be completed before you attend your lab section for an experiment. Pre-labs should include all the necessary detail as described in the lab manual. If the pre-lab is not completed before a lab, then students will not be allowed to perform the lab and a mark of zero will be assigned for that lab.
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Laboratory reports are due one week after completing the experiment (by 11:59 pm). For example, if you complete the silicone bouncing putty experiment on Tuesday Feb 8th then your report must be handed in by February 15th. Any document that is uploaded after the due date will be subject to the Chem 2281 late penalty. Laboratory reports should generally be marked by the next lab session after you hand them in.

Formal Laboratory Write-up – You are required to write one formal laboratory report, which will be on Carbon Quantum Dots. The report must be prepared using 12 pt, Times Roman font, with 2.54 cm margins around the whole page and 1.5 line spacing. Chemical drawings are to be done using ChemDraw, which is freely available to all Western students. This software is the industry standard for preparing chemical drawings for a formal document. Formatting and document presentation will be assigned 2 of the 20 marks. The report should include all of the same things outlined above in the What to Include in your Laboratory Notebook section, however the procedure must be written out in full, not point form and in your own words.

Laboratory Schedule (subject to change depending on University/provincial health guidelines or restrictions)

<table>
<thead>
<tr>
<th>Week of</th>
<th>Experiment</th>
<th>Due Week of*</th>
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<tbody>
<tr>
<td>Jan. 24</td>
<td>Library Lab (via Zoom)</td>
<td>Jan. 31</td>
</tr>
<tr>
<td>Jan. 31</td>
<td>Symmetry Tutorial</td>
<td>Jan 31 (in lab)</td>
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<tr>
<td>Feb. 7</td>
<td>Exp. 1</td>
<td>Feb. 14</td>
</tr>
<tr>
<td>Feb. 14</td>
<td>Exp. 2</td>
<td>Feb. 28</td>
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<tr>
<td>Feb. 21</td>
<td><strong>READING WEEK</strong></td>
<td></td>
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<tr>
<td>Feb. 28</td>
<td>Exp. 3</td>
<td>Mar. 7</td>
</tr>
<tr>
<td>Mar. 7</td>
<td>Exp. 4</td>
<td>Mar. 14</td>
</tr>
<tr>
<td>Mar. 14</td>
<td>Exp. 5</td>
<td>Mar. 21</td>
</tr>
<tr>
<td>Mar. 21</td>
<td>Exp. 6</td>
<td>Mar. 28</td>
</tr>
</tbody>
</table>

April 8 – Last Day of Classes
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Other things to consider...

Accommodation and accessibility

Accommodation Policies – Students with disabilities work with Accessible Education (formerly SSD) which provides recommendations for accommodation based on medical documentation or psychological and cognitive testing. The Academic Accommodation for Students with Disabilities policy can be found at: https://www.uwo.ca/univsec/pdf/academic_policies/appeals/AcademicAccommodation_disabilities.pdf

Academic Consideration for Student Absence – Students will have up to two (2) opportunities during the regular academic year to use an on-line portal to self-report an absence during the semester, provided the following conditions are met: the absence is no more than 48 hours in duration, and the assessment for which consideration is being sought is worth 30% or less of the student’s final grade. Students are expected to contact their instructors within 24 hours of the end of the period of the self-reported absence, unless noted on the syllabus. Students are not able to use the self-reporting option in the following circumstances:

- for exams scheduled by the Office of the Registrar (e.g., December and April exams)
- absence of a duration greater than 48 hours,
- assessments worth more than 30% of the student’s final grade,
- if a student has already used the self-reporting portal twice during the academic year

If the conditions for a Self-Reported Absence are not met, students will need to provide a Student Medical Certificate if the absence is medical, or provide appropriate documentation if there are compassionate grounds for the absence in question. Students are encouraged to contact their Faculty academic counselling office to obtain more information about the relevant documentation.

Students should also note that individual instructors are not permitted to receive documentation directly from a student, whether in support of an application for consideration on medical grounds, or for other reasons. All documentation required for absences that are not covered by the Self-Reported Absence Policy must be submitted to the Academic Counselling office of a student's Home Faculty.

For policy on Academic Consideration for Student Absences - Undergraduate Students in First Entry Programs, see:

https://www.uwo.ca/univsec/pdf/academic_policies/appeals/Academic_Consideration_for_absences.pdf

and for the Student Medical Certificate (SMC), see:

http://www.uwo.ca/univsec/pdf/academic_policies/appeals/medicalform.pdf
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Religious Accommodation – Students should consult the University’s list of recognized religious holidays, and should give reasonable notice in writing, prior to the holiday, to the Instructor and an Academic Counsellor if their course requirements will be affected by a religious observance. Additional information is given in the Western Multicultural Calendar: https://multiculturalcalendar.com/ecal/index.php?s=c-univwo

You may also be eligible to write the Special Exam if you are in a “Multiple Exam Situation” (see http://www.registrar.uwo.ca/examinations/exam_schedule.html).

Specifics for Chem 2281
Tests – If a test is missed for valid reasons (see process for seeking academic consideration above) the weighting will be transferred to the final examination.

Laboratory - If a lab is missed for valid reasons (see process for seeking academic consideration above) please contact JFC immediately. In such situations it is normally expected that a lab report (including prelab) will still be submitted. JFC will provide details.

Final Exam – If you miss the Final Exam, please contact your faculty’s Academic Counselling Office as soon as you are able to do so. They will assess your eligibility to write the Special Exam (the name given by the university to a makeup Final Exam). You may also be eligible to write the Special Exam if you are in a “Multiple Exam Situation” (see http://www.registrar.uwo.ca/examinations/exam_schedule.html).

Academic Policies
The website for Registrar Services is http://www.registrar.uwo.ca.

In accordance with policy, http://www.uwo.ca/its/identity/activatenonstudent.html, the centrally administered e-mail account provided to students will be considered the individual’s official university e-mail address. It is the responsibility of the account holder to ensure that e-mail received from the University at his/her official university address is attended to in a timely manner.

Online Learning
Lecture Recording – Participants in this course are not permitted to record the sessions, except where recording is an approved accommodation, or the participant has the prior written permission of the instructor.

Academic Offences – Scholastic offences are taken seriously and students are directed to read the appropriate policy, specifically, the definition of what constitutes a Scholastic Offence, at the following web site: http://www.uwo.ca/univsec/pdf/academic_policies/appeals/scholastic_discipline_undergrad.pdf.
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Students must write their work in their own words! Whenever a student (or any scientist) takes an idea or passage from another author, they must acknowledge their debt both by using quotation marks where appropriate and by proper referencing such as footnotes or citations.

All required reports may be subject to submission for textual similarity review to the commercial plagiarism detection software under license to the University for the detection of plagiarism. All reports submitted for such checking will be included as source documents in the reference database for the purpose of detecting plagiarism of papers subsequently submitted to the system. Use of the service is subject to the licensing agreement, currently between Western University and Turnitin.com (http://www.turnitin.com).

Test Proctoring – Tests and examinations in this course may be conducted using Zoom and/or a remote proctoring service, such as Proctortrack. Specifics will be implemented closer to the tests.

If Zoom is used for exam invigilation, you will be required to keep your camera on for the entire session, hold up your student card for identification purposes, and share your screen with the invigilator if asked to do so at any time during the exam.

Proctortrack will require you to provide personal information (including some biometric data). The session will be recorded. By taking this course, you are consenting to the use of this software.

More information about remote proctoring is available in the Online Proctoring Guidelines at the following link: https://www.uwo.ca/univsec/pdf/onlineproctorguidelines.pdf

Completion of this course will require you to have a reliable internet connection and a device that meets the system and technical requirements for both Zoom and Proctortrack. Information about the system and technical requirements are available at the following links: https://www.proctortrack.com/tech-requirements/  https://support.zoom.us/hc/en-us

*Note - Zoom servers are located outside Canada. If you would prefer to use only your first name or a nickname to login to Zoom, please provide this information to the instructor in advance of the test or examination.

Statements concerning online etiquette – Some components of this course will involve online interactions. To ensure the best experience for both you and your classmates, please honour the following rules of etiquette:

• “arrive” to class on time.
• use your computer and/or laptop if possible (as opposed to a cell phone or tablet).
• ensure that you are in a private location (if possible) to protect the confidentiality of discussions in the event that a class discussion deals with sensitive or personal material.
• to minimize background noise, mute your microphone for the entire class until you are invited to speak, unless directed otherwise.
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• In order to give us optimum bandwidth and web quality, turn off your video camera for the entire class unless you are invited to speak.
• Please be prepared to turn your video camera off at the instructor’s request if the internet connection becomes unstable.
• Unless invited by your instructor, do not share your screen in the meeting.

The course instructor will act as moderator for the class and will deal with any questions from participants (generally via the chat feature). To participate please consider the following:

• If you wish to speak, use the “raise hand” function and wait for the instructor to acknowledge you before beginning your comment or question.
• Please remember to unmute your microphone and turn on your video camera before speaking.
• Self-identify when speaking.
• Please remember to mute your mic and turn off your video camera after speaking (unless directed otherwise).

General considerations of “netiquette”
• Keep in mind the different cultural and linguistic backgrounds of the students in the course.
• Be courteous toward the instructor, your colleagues, and authors whose work you are discussing.
• Be respectful of the diversity of viewpoints that you will encounter in the class and in your readings. The exchange of diverse ideas and opinions is part of the scholarly environment. “Flaming” is never appropriate.
• Be professional and scholarly in all online postings. Use proper grammar and spelling. Cite the ideas of others appropriately.

Note that disruptive behaviour of any type during online classes, including inappropriate use of the chat function, is unacceptable. Students found guilty of Zoom-bombing a class or of other serious online offenses may be subject to disciplinary measures under the Code of Student Conduct.